

LARVAE OF SOME EUSOCIAL BEES AND WASPS¹

By George C. Wheeler and Jeanette Wheeler²

ABSTRACT: The larvae of 17 species of social wasps in the genera *Apoica*, *Belonogaster*, *Microstigmus*, *Mischocyttarus*, *Polistes*, *Polybia*, *Ropalidia*, *Synoeca* and *Vespa* are described and many figured; the same for eight species of social bees in the genera *Apis*, *Bombus*, *Braunsapis*, *Lasioglossum*, *Melipona* and *Trigona*. Appended are a list of published descriptions and illustrations of the larvae of eusocial wasps and bees, a list of the published characterizations of the larvae of the higher taxa and a list of published keys to larvae.

When we were invited to write the chapter on the larvae of social Hymenoptera for "Social Insects," H.R. Hermann, ed., Academic Press (1979), we had no misgivings about ant larvae, because we had just finished a monograph about them (1976), based on a leisurely half-century of the study of 692 species in 182 genera representing all 10 of the living subfamilies. But about eusocial bee and wasp larvae we knew nothing and we had less than a year to learn. We sent out appeals for specimens and references. We acknowledge the generous responses with advice and/or specimens from the following: D.R. Davis, National Museum of Natural History, Smithsonian Institution; Howard E. Evans, Colorado State University; Saul I. Frommer, University of California, Riverside; Charles D. Michener, University of Kansas; Jerome G. Rozen, American Museum of Natural History; Robert O. Schuster, University of California, Davis; Roy R. Snelling, Natural History Museum, Los Angeles County; Philip F. Torchio, Utah State University.

We processed representatives of 16 species of eusocial wasps and eight species of eusocial bees by the techniques (1960) we had used for ant larvae and prepared descriptions according to our paradigm (1976: 2–3); drawings were prepared according to the style we had developed for ant larvae. As in our ant larvae papers we used the integuments of the largest larvae which had not defecated. We follow Snodgrass (1960) in considering post-defecation larvae as pharate pupae (= semipupae). Those studies gave us a good acquaintance at first hand with these larvae, but there was no room in our chapter for this material. It seems unfortunate to us that the detailed results of so much labor should not be publicly available; hence we are publishing them herewith.

In our chapter on social Hymenoptera we did not refer to the larvae of the sphecids in the genus *Microstigmus*, because we were not certain they were eusocial. Since then Roy R. Snelling, Los Angeles County Museum, has assured us that they are indeed eusocial. We follow his advice and a description of the larvae of *Microstigmus comes* Krombein is included here. This makes a total of 17 species of eusocial wasps we have studied.

We also asked specialists if they kept (or knew of) a catalog of published figures and/or descriptions of the larvae of eusocial bees and wasps. Such a catalog would have saved us considerable time in learning what was already known. No one had (or

knew of) such a catalog; but some said that it would be extremely useful.³

We therefore append below a list of those species of eusocial wasps and bees whose larvae we have found described and/or illustrated in the literature. The list is incomplete, for we have not had the time to search the literature (as we did for the ants), but it can be used as a starting point for specialists. We hope that they will bring it up to date and keep it so, in order that future students will not be caught in our predicament.

TERMS

We follow Snodgrass in regarding the head of an insect—either larva or adult—as hypognathous. Consequently we consider the face to be anterior and the vertex dorsal, while the mouth parts are directed ventrally.

The praesaepium is a shallow depression on the ventral surface of certain anterior somites; it resembles somewhat the trophothylax of the pseudomyrmecine ant larvae and serves the same function: the workers deposit food in it and the larvae eat from it.

We use T1, T2 and T3 as symbols for the thoracic somites and A1 to AX for the abdominal somites.

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³"Discovering from the literature what species have been described as larvae is most difficult for obvious reasons. Hence I cannot but feel that a published list of social bees (and presumably other Hymenoptera) might be a significant contribution to the work of others in the future." (Dr. Jerome G. Rozen in a letter of 4 March 1976.)

VESPOIDEA

Body profile straight and fusiform; diameter greatest at A1 and A11; gradually attenuated toward posterior end and more rapidly toward anterior end; with temporary trophothylax (= praesaepium), except in *Mischocyttarus* which has a permanent shelf; transverse welts on dorsum of some somites. Hairs usually lacking or minute and simple. Mandibles highly varied.

VESPIDAE: POLISTINAE

Apoica pallens (Fabricius)

Figure 1

Length (through spiracles) about 18 mm. Body straight; dorsal profile arcuate; ventral nearly straight, except head and terminal somites curved slightly ventrally; mouth parts directed antero-ventrally. Anus terminal; with prominent lips. Leg and gonopod vestiges small knobs; wing rudiments brown lines on unstained integuments. **Spiracles** small; peritreme feebly sclerotized; atrial wall with minute spinules in encircling rows. Entire integument spinulose, the spinules large and isolated anteriorly, becoming smaller and in short rows posteriorly. **Body hairs** moderately abundant on dorsal and lateral surfaces, minute (about 0.09 mm long), fewer ventrally, very fine and flexuous. **Cranium** not sclerotized (= same color as body); large (about 2.34 mm wide and 1.9 mm long); subpentagonal in anterior view, widest immediately below antennal level; with distinct temporal sulci, the lateral portions appearing sieve-like. Antennae just below mid-length of cranium; each mounted on large slightly elevated base; small; with 4 sensilla, each bearing a minute spinule. Head hairs (and/or minute sensilla) 0.003–0.025 mm long; numerous. **Labrum** bilobed; dorsal border sinuate; each half of anterior surface with about 25 minute (about 0.013 mm long) hairs dorsally and sensilla ventrally; ventral surface with about 25 large projecting sensilla medially and 6 smaller sensilla laterally on each half; posterior surface spinulose, the spinules minute and in short rows ventrally; longer and isolated laterally; posterior surface with about 6 sensilla medially. **Mandible** small (about 0.36 mm wide and 0.64 mm long), moderately sclerotized; falcate; tapering to a very sharp apical tooth with medial blade; a narrowly rounded long tooth projecting anteromedially from blade. **Maxilla** appearing adnate; stripes with about 24 hairs (about 0.025 mm long, simple, slender) on lateral surface; medial and apical surfaces sparsely spinulose, spinules minute; palp a slender peg with 4 apical sensilla; galea stouter than palp and with bifid apex; one branch of apex with 4 sensilla, the other with 1. **Labium** small, surface with fine rugulae; palp a frustum with 4 apical sensilla; an isolated hair (about 0.03 mm long) between each palp and opening of sericteries, the latter wide and feebly projecting. Hypopharynx rugulose. (Material studied: three larvae from Costa Rica, courtesy of Roy R. Snelling.)

Belonogaster lateritius Gerstaecker

Figure 2

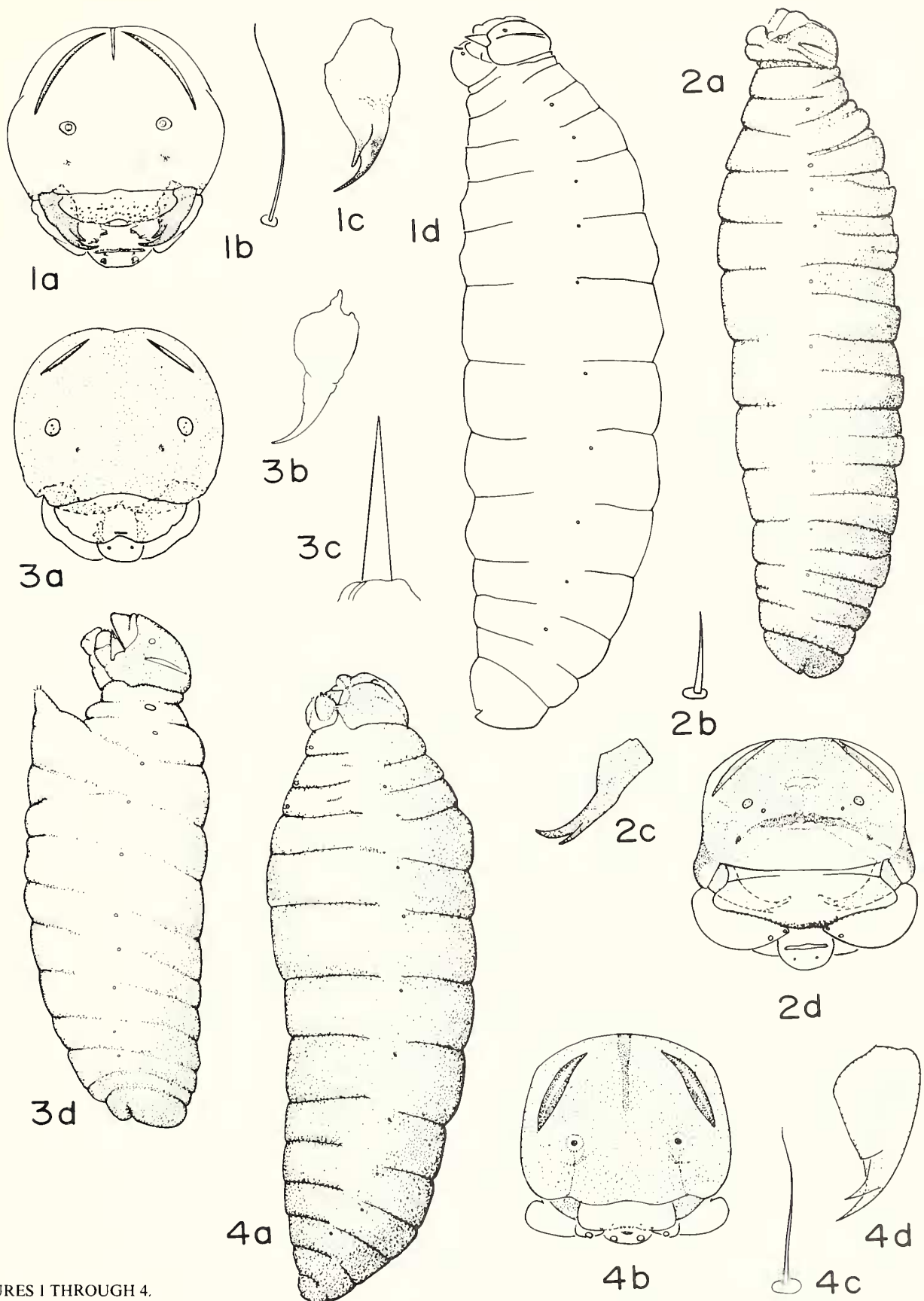
Length (through spiracles) about 22 mm. Body straight and stout; diameter greatest at A11; a pair of transverse welts on dorsum of each A1–AV1; each lateral surface of A1 with a circular

raised area; venter of T1–T3 and A1 forming floor of praesaepium, A11 swollen and forming its ventral lip. Head large and terminal. Anus terminal. Leg, wing and gonopod vestiges present. Integument around **spiracles** markedly sclerotized. **Integument** entirely spinulose, spinules long (about 0.013 mm). **Body hairs** sparse, minute (about 0.013 mm long), simple. **Cranium** heavily sclerotized (= dark brown); subquadrangular, widest at mandible level; about 2.9 mm wide and 1.76 mm long; major portion sclerotized; portion of frons and ventral portion of labrum heavily sclerotized (= dark brown); temporal sulci well developed; pleurostoma feebly sclerotized. Antennae near mid-length of cranium; each a low rounded elevation, with 3 sensilla, each of which bears a minute spinule. **Labrum** nearly as wide as head, about 2.2 mm wide and 0.76 mm long; trapezoidal, widest ventrally; ventral and dorsal borders sinuate; ventral border with about 90 sensilla, most of which are on short sclerotized pegs, some on same level as integument and bearing a minute spinule each; anterodorsal portion with about 14 hairs and/or sensilla; integument with minute spinules, isolated or in very short rows. **Mandible** long and slender (about 0.36 mm wide and 1.3 mm long); feebly sclerotized; apex forming a long slender medially curved tooth which bears an anteromedial tooth. **Maxilla** large and lobose; cardo with numerous large isolated spinules and with about 30 hairs, which are about 0.025 mm long and spike-like; stipes with minute isolated spinules; palp a short peg with 4 apical sensilla, its integument with minute spinules in short encircling rows; galea digitiform, with 2 apical sensilla. **Labium** small; integument roughened with short arcuate rows of spinules medially, spinules few and isolated laterally; palp a short peg with 4 or 5 sensilla; opening of sericteries wide and salient. **Hypopharynx** rugulose, some rugulae bearing a few minute spinules. (Material studied: four larvae from Kenya, courtesy of Roy R. Snelling.)

Mischocyttarus flavitarsis (Saussure)

Figure 3

Length (through spiracles) about 13 mm. Body with thorax narrowed anteriorly; abdomen widest at A11, decreasing to narrowly rounded posterior end, with a pair of small knobs on dorsum of each T2–A1X; praesaepium floor T1–T3; A1 projecting ventrally into 2 spinulose cones. Anus terminal. Head on anterior end; its diameter greater than that of T1 or T2. **Spiracles**: diameter of T2 spiracular atrium twice diameter of remainder; atrial walls with encircling rows of minute spinules. **Integument** of body spinulose, spinules in short rows or isolated on ridges, ridges numerous and transverse or reticulate. **Body hairs** few, stout, 0.025–0.1 mm long, only on ventral projection on A1. **Cranium** moderately sclerotized (= light brown); feebly subcordate; about 2.4 mm wide and 2.16 mm long; with numerous minute sensilla; temporal sulci present. Antennae small; just below midlength of cranium. **Labrum** bilobed, wide and short (about 1.56 mm wide and 0.48 mm long); anterior surface of each half with a small ventrolateral boss, which bears about 25 minute hairs and/or sensilla; entire anterior surface rugulose; posterior surface of each half with about 20 sensilla, each of which is mounted on a slight projection. **Mandible** falcate; long and slender (about 0.4 mm wide and 0.98 mm long), with very slender apex. **Maxilla** lobose; palp digitiform with 5 (2 apical, 2 sub-apical and 1 basal) sensilla; galea digitiform, more slender than



FIGURES 1 THROUGH 4.

FIGURE 1. *Apoica pallens*. a, Head in anterior view, X22; b, body hair, X390; c, left mandible in anterior view, X40; d, larva in side view, X7. FIGURE 2. *Belonogaster lateritius*. a, Larva in side view, X5.5; b, body hair, X600; c, left mandible in anterior view, X21; d, head in anterior view, X13. FIGURE 3. *Mischocyttarus flavitarsis*. a, Head in anterior view, X14; b, left mandible in anterior view, X94; c, body hair, X1390; d, larva in side view, X14. FIGURE 4. *Polistes exclamans lineonotus*. a, Larva in side view, X7; b, head in anterior view, X15; c, body hair, X400; d, left mandible in anterior view, X38.

palp but about as long, with 2 apical sensilla. **Labium** small and rounded; sparsely spinulose, spinules minute and in short transverse rows; palp a low knob; an isolated sensillum between each palp and opening of sericteries; the latter wide and salient. **Hypopharynx** densely spinulose, spinules arranged in subtransverse rows, rows so close together that spinules overlap. (Material studied: four larvae from Arizona, courtesy of Roy R. Snelling.)

Polistes exclamans lineonotus R. Bohart

Figure 4

Length (through spiracles) about 17 mm. Body straight; dorsal profile arcuate, ventral feebly sigmoid; diameter greatest at AII, decreasing slowly to posterior end (which is narrowly round-pointed) and more rapidly to anterior end; head terminal and slightly smaller than diameter of T1. Anus ventral. A small boss posterior to anus on AX; lateral longitudinal welts well developed; paired bosses on T2, T3 and A1–AIX; praesaepium floor formed from depressed ventral surfaces of T1–T3 and A1, ventral wall formed from an anteroventral extension of AII. Leg vestiges rather large, each with sclerotized ring; wing rudiments present. **Spiracles** on T2 largest, remainder small and subequal. Entire **integument** spinulose, the spinules coarse and isolated ventrally, grading into minute and in short rows dorsally, on thorax and anterior abdominal somites; posterior spinules finer and less numerous. **Body hairs** sparse, simple, minute to short (0.005–0.06 mm long), most numerous on venter of T3 and A1. **Cranium** moderately sclerotized (= light brown); subtrapezoidal in anterior view, widest ventrally (about 2.45 mm wide and 1.68 mm long); temporal sulci long and wide. Antennae just below midlength of cranium; each a low knob with 3 or 4 sensilla. Head hairs numerous (about 200) and minute (about 0.008 mm long). **Labrum** short and trapezoidal; narrowed ventrally (about 1.27 mm wide and 0.42 mm long); entire anterior surface with about 120 minute hairs (0.005–0.03 mm long) and/or sensilla (each bearing a spinule); ventral border with about 30 sensilla (some heavily sclerotized and elevated) and with numerous minute spinules; posterior surface with about 24 sensilla and with a few minute spinules in short rows. **Mandible** falcate; about 0.44 mm wide and 0.84 mm long; with a rather long tooth arising from the anterior surface and with a very small tooth between it and apical tooth; anterior surface with a few transverse rugulae; posterior surface with longitudinal rugulae. **Maxilla** appearing adnate; swollen and lobose laterally; with about 45 minute to short (0.005–0.03 mm long) hairs; with minute isolated spinules medially, in short arcuate rows laterally and posteriorly, palp a tall peg with 5 or 6 apical sensilla; galea an irregular peg with 5 apical sensilla. **Labium** small and globose, with about 50 minute to short (0.005–0.03 mm long) hairs between palps and opening of sericteries; hairs continued onto posterior surface; each palp a small boss with 5 apical sensilla; opening of sericteries as wide as labium and slightly salient. **Hypopharynx** with a few minute ridges (rows of spinules?). (Material studied: five larvae from Mexico, courtesy of Roy R. Snelling.)

Polistes erythrocephalus Latreille

Length (through spiracles) about 25 mm. Similar to *P. exclamans lineonotus* except as follows. Body with a small mid-

dorsal boss on AIX; anus terminal; ventral profile feebly J-shaped. **Integument** with spinules all rather coarse and isolated. **Cranium** about 3.1 mm wide and 2.6 mm long; integument minutely reticulorugose and with numerous sensilla. Each antenna with 3–7 sensilla. No head hairs seen. **Labrum** about 1.6 mm wide and 0.6 mm long; subrectangular, with a slight median impression; about 130 hairs and/or sensilla (each bearing a spinule) on anterior surface. **Mandible** about 0.42 mm wide and 1.2 mm long; with subapical tooth slightly smaller than apical. **Maxilla** with about 30 minute hairs and/or sensilla; palp a paxilla with 6 or 7 apical sensilla; galea an irregular cluster of about 7 irregularly elevated sensilla. **Labium** with hairs 0.025–0.05 mm long, simple and slender; palp a low knob with 5 or 6 sensilla. **Hypopharynx** with short arcuate rows of minute spinules. (Material studied: three larvae from Costa Rica, courtesy of Roy R. Snelling.)

Polistes fuscatus (Fabricius)

Length (through spiracles) about 13 mm. Similar to *P. exclamans lineonotus* except as follows. Body with a chair-shaped knob terminally on AX; a small projection directed anteriorly dorsal to each spiracle of AV; A1–AVII a pair of transverse bosses meeting at middorsum, a pair per somite; A1 or AII forming ventral surface of praesaepium. **Integument** of dorsal bosses without spinules. **Body hairs** 0.05–0.125 mm long; most numerous and longest on T3, A1 and AX. **Cranium** and mouth parts heavily sclerotized (= dark brown); cranium about 2.8 mm wide and 1.8 mm long. Each antenna with 3–5 sensilla. About 300 head hairs 0.01–0.1 mm long, longest with flexous tip. **Labrum** about 1.4 mm wide and 0.44 mm long; feebly bilobed; each half of anterior surface with about 30 hairs (0.012–0.027 mm long) and minute sensilla; posterior surface with 7 sensilla on each half and with a few minute spinules in short arcuate rows. **Mandible** about 0.35 mm wide and 0.78 mm long; apical tooth with a small medial blade; apical and subapical teeth subequal. **Maxilla** with hairs 0.025–0.625 mm long; palp a short peg; galea taller. **Labium** with palp a short peg. **Hypopharynx** with a few minute spinules in short arcuate rows. (Material studied: three larvae from Colorado, courtesy of H.E. Evans.)

Polistes fuscatus aurifer Saussure

Length (through spiracles) about 17 mm. Similar to *P. exclamans lineonotus* except as follows: Body stout; dorsal profile J-shaped, ventral profile S-shaped; diameter greatest at AIII; with paired dorsal bosses on T3–AIX; single more prominent boss on AX. Entire **integument** with large isolated spinules. **Body hairs** longer (0.012–0.1 mm long). **Cranium** about 2.7 mm wide and 2 mm long; transversely subelliptical in anterior view; dorsal border feebly impressed. Head hairs twice as numerous (about 400) and longer (0.01–0.1 mm long). **Labrum** feebly bilobed; about 1.39 mm wide and 0.48 mm long; posterior surface with about 14 sensilla. **Mandible** about 0.38 mm wide and 0.9 mm long. **Maxilla** with palp and galea subequal in height. **Labium** with hairs about 0.05 mm long and simple or about 0.025 mm long and bifid at tip. **Hypopharynx** with sparse minute spinules. (Material studied: three larvae from California, courtesy of R.O. Schuster.)

Polistes major castaueicolor Bequaert

Length (through spiracles) about 37 mm. Similar to *P. exclamans lineonotus* except as follows. Body with a pair of welts on dorsum of each A1–AVI. **Integument** with all spinules minute. **Body hairs** 0.01–0.15 mm long, longest and most numerous on venter of AII, the longest flexuous. **Cranium** heavily sclerotized (= dark brown); about 2.9 mm wide and 1.9 mm long. Antennae above midlength of cranium. Head hairs about 400, 0.06–0.18 mm long, very slender and flexuous. **Labrum** about 1.6 mm wide and 0.6 mm long; transversely subelliptical in anterior view; anterior surface with about 90 sensilla and minute hairs (about 0.025 mm long). **Mandible** about 0.52 mm wide and 0.86 mm long. **Maxilla** with about 20 hairs, 0.01–0.05 mm long; palp stout and digitiform, with 4 apical and 2 lateral sensilla, integument with a few minute spinules; galea digitiform, with bifid apex, the larger branch with 5 or 6 apical sensilla, the smaller with 1 apical sensillum. **Labium** with palp a short peg with 7 or 8 apical and 1–3 lateral sensilla; integument with isolated spinules and about 24 short (0.012–0.025 mm long) hairs, the longer with bifid apex. **Hypopharynx** with a few minute spinules in short arcuate rows. (Material studied: two larvae from Arizona, courtesy of Roy R. Snelling.)

Polistes poeyi Lepeletier

Length (through spiracles) about 13 mm. Similar to *P. exclamans lineonotus* except as follows. Entire **integument** spinulose, the spinules numerous, isolated and large on thorax and dorsum of A1–AX and venter of A1–AIV, less abundant and smaller posteriorly. **Body hairs** simple; most numerous and longest (0.005–0.1 mm) on venter of A1, fewer and shorter anteriorly and posteriorly. **Cranium** heavily sclerotized (= dark brown), about 2.4 mm wide and 1.6 mm long. Antennae above midlength of cranium, each with a heavily sclerotized ring, elevated, with 2 or 3 sensilla. Head hairs about 130 and minute (about 0.005 mm long). **Labrum** about 1.25 mm wide and 0.4 mm long; transversely subelliptical; entire anterior surface with about 8 sensilla and a few isolated spinules; ventral border with about 12 sensilla; posterior surface with about 25 sensilla, most numerous dorsally and near midline ventrally; posterior surface with a few minute spinules in short arcuate rows. **Mandible** about 0.36 mm wide and 0.9 mm long; small medial tooth lacking. **Maxilla** less swollen laterally; anterior surface with about 35 simple, very slender hairs, 0.006–0.025 mm long; medial surface with minute spinules, spinules isolated or in short rows; palp stout, digitiform, with 4 or 5 apical sensilla; galea approximately same size as palp but with an irregular apex, with 5–7 apical sensilla. **Labium** small, transversely subelliptical, with a slightly raised, sparsely spinulose, transverse welt dorsally, with about 12 hairs (0.005–0.025 mm long) near each palp; palp a low knob with 4 apical sensilla. **Hypopharynx** with sparse isolated spinules. (Material studied: two larvae from Cuba, courtesy of Roy R. Snelling.)

Polybia occidentalis (Olivier)

Figure 5

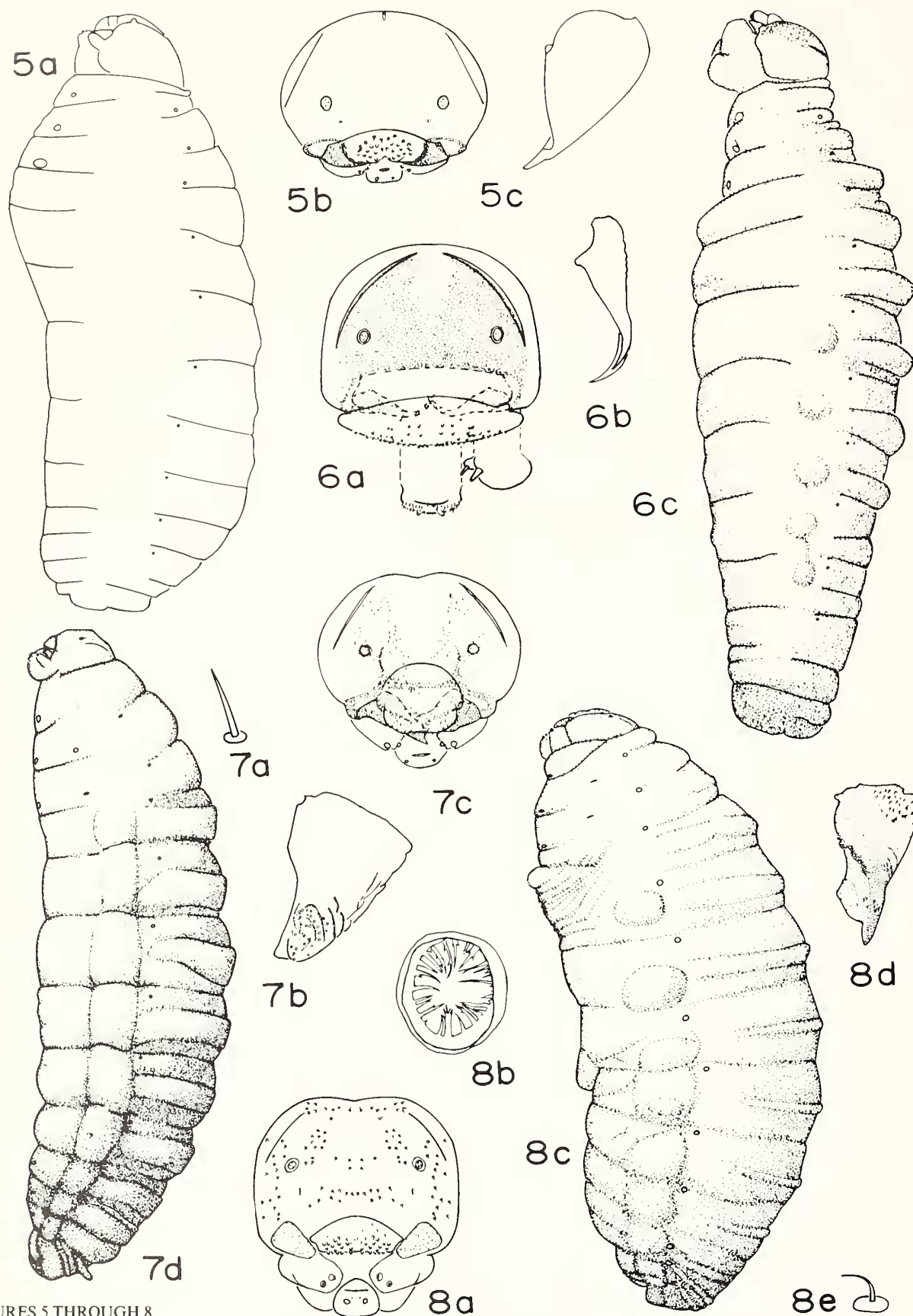
Length (through spiracles) about 6 mm. Body straight; stout; diameter greatest at A1 and AII, diameter decreasing rapidly an-

teriorly and gradually posteriorly. Anus terminal. Head on anterior end, with diameter greater than that of A1; T2, T3 and A1 with paired dorsolateral denticles. Leg, wing and gonopod vestiges distinct. **Spiracles** small; T2 largest, remainder subequal. **Integument** spinulose, spinules isolated and coarse, decreasing in size and number posteriorly. No **body hairs** seen. **Cranium** large, about 1.24 mm wide and 0.74 mm long; transversely subelliptical in anterior view; feebly sclerotized (= yellow); temporal sulci long. Antennae large; at lower third of cranium; each with 3 sensilla. **Labrum** short (about 0.45 mm wide and 0.1 mm long) and bilobed; each half of anterior surface with about 12 sensilla (each on a small peg), 5 hairs (about 0.125 mm long) and numerous papillae; ventral border with papillae and about 9 sensilla; posterior surface with an isolated sensillum near middle and with a few oblique arcuate rows of minute spinules. **Mandible** small, about 0.2 mm wide and 0.24 mm long, falcate, with irregular apex; a subapical lateral tooth, a crooked apical tooth and a short medial blade; basal portion with short arcuate ridges, apical portion with a few longitudinal ridges. **Maxilla** appearing adnate; basal surface with numerous rather coarse spinules, apical with about 10 hairs about 0.13 mm long, and numerous short ridges; palp a short rugose irregular peg with 5 apical sensilla; galea an irregular rugose boss with 2 sensilla, each on a slight elevation. **Labium** transversely subelliptical; with short transverse ridges; palp a cluster of 4–6 slightly elevated sensilla; an isolated sensillum between each palp and opening of sericteries; the latter a transverse slit with lips as wide as labium. **Hypopharynx** sparsely spinulose, the spinules minute and in short transverse rows. (Material studied: five larvae from Costa Rica, courtesy of Roy R. Snelling.)

Ropalidia cincta (Lepeletier)

Figure 6

Length (through spiracles) about 18 mm. Body fusiform; head and anus terminal; thorax slender; abdomen abruptly enlarged; venter of T1–T3 forming floor of praesaepeum; A1 produced ventrally to form its lip; transverse welts meeting on middorsum of T1–AVII, a pair each; diameter of head nearly equal to that of T2. Leg, wing and gonopod vestiges present. **Spiracles** on T2 about twice diameter of remainder. **Integument** entirely spinulose, the spinules rather large and isolated, largest on A1, abruptly reduced on AIX, lacking on AX. **Body hairs** 0.005–0.025 mm long, sparse, simple, very fine. **Cranium** about 2.9 mm wide and 1.6 mm long; semicircular in anterior view; heavily sclerotized (= dark brown) between sulci and to its ventral border, excluding clypeus; sclerotization heaviest along ventral border of cranium and of labrum; temporal sulci long and narrow; clypeus with about 34 sensilla. Antennae at lowest third of cranium; large; each a slightly raised circle with 3 minute sensilla. **Labrum** trapezoidal in anterior view, narrowed dorsally, very short and wide (about 0.4 mm long and 2.1 mm wide); anterior surface with about 30 sensilla and with minute hairs (about 0.012 mm long); ventral border and adjacent portions of anterior and posterior surfaces with about 66 sensilla, each on a low knob; posterior surface with numerous short rows of minute spinules. **Mandible** large (about 0.4 mm wide and 1.2 mm long); slender; falcate; apical tooth slender and sharp-pointed, with a slender sharp-pointed anterior tooth; mandible with a dark band around basal edge. **Maxilla** lobose ventrolaterally; anterior



FIGURES 5 THROUGH 8.

FIGURE 5. *Polybia occidentalis*. a, Larva in side view, X18; b, head in anterior view, X30; c, left mandible in anterior view, X50. FIGURE 6. *Ropalidia cincta*. a, Head in anterior view (left maxilla and labium normally hidden behind labrum but drawn here separately), X13; b, left mandible in anterior view, X25; c, larva in side view, X7. FIGURE 7. *Synoeca surinama*. a, Body hair, X400; b, left mandible in anterior view, X56; c, head in anterior view, X15; d, larva in side view, X5.5. FIGURE 8. *Vespula maculata*. a, Head in anterior view, X17; b, spiracle, X200; c, larva in side view, X3.5; d, left mandible in anterior view, X40; e, body hair, X508.

surface with about 20 hairs (about 0.25 mm long) and minute spinules; appearing adnate; palp digitiform, with 4 apical and 1 lateral sensilla, integument of palp with minute spinules in short transverse rows; galea slightly shorter and slenderer, with 2 apical sensilla. **Labium** short and subtrapezoidal in anterior view, slightly wider basally; with large transverse dorsal welt; palp a peg with 2 apical sensilla and 4 adjacent slightly raised sensilla; area between each palp and opening of sericteries with long slender spinules; an isolated sensillum between each palp and opening of sericteries; the latter wide and transverse, with slightly protruding lips. **Hypopharynx** with numerous minute spinules in short transverse rows. (Material studied: four larvae from Kenya, courtesy of Roy R. Snelling.)

Synoeca surinama (Fabricius)

Figure 7

Length (through spiracles) about 24 mm. Body fusiform; nearly straight; diameter greatest at AIII, attenuated gradually toward each end; lateral longitudinal welts on sides of abdomen; a pair of transverse welts meeting at midline on dorsum of each AI–AVII; AIX with digitiform middorsal projection. No suggestion of a praesaepium. Leg, wing and gonopod vestiges dark brown. **Spiracles** with minute spinules in transverse rows on atrial wall. Entire **integument** spinulose, spinules longer and isolated anteriorly, minute and in rows posteriorly. **Body hairs** 0.025–0.05 mm long; simple spikes; most numerous on venter of thorax and anterior abdominal somites, sparse elsewhere. **Cranium** feebly sclerotized (= yellow); feebly bilobed due to median impression of dorsal border; about 2.6 mm wide and 1.8 mm long; temporal sulci long and slender. Antennae at midlength of cranium; each with sclerotized border and with 3 minute sensilla. Head hairs short (0.019–0.037 mm long), spike-like and numerous (about 220). **Labrum** short (about 1.4 mm wide and 0.4 mm long), transversely subelliptical; anterior surface with about 24 hairs (about 0.03 mm long) dorsally and numerous sensilla (each mounted on a small papilla); ventral border thick and feebly sclerotized, with sensilla on small papillae; posterior surface with small papillae and with minute spinules in short arcuate rows. **Mandible** small about 0.45 mm wide and 0.55 mm long; subpentagonal in anterior view, distal end blunt; apex sclerotized, with a small boss directed anteromedially and bearing a few rows of minute spinules; subapical portion with about 36 minute sensilla; medial portion with minute spinules in short transverse rows; basal portion reticulorugose and with minute spinules in short transverse rows. **Maxilla** appearing adnate; cardo swollen ventrolaterally, with about 6 hairs (about 0.05 mm long); stipe rather slender and with about 18 hairs (about 0.25 mm long); palp sclerotized, an irregular peg with 5 sensilla, subequal to galea; galea with 2 apical sensilla. **Labium** small, transversely subelliptical in anterior view, dorsal portion densely spinulose, the spinules long and slender; palp sclerotized, a small peg with 3 apical sensilla; an isolated sensillum between each palp and opening of sericteries; the latter a transverse slit, with lips as wide as labium. **Hypopharynx** with numerous short transverse ridges bearing minute spinules. (Material studied: three larvae from Mexico, courtesy of Roy R. Snelling.)

VESPINAE

Vespula maculata (Linnaeus)

Figure 8

Length (through spiracles) about 19 mm. Body stout and slightly curved ventrally; head moderately large and anteroventral; anus terminal; AX with 2 stout posterodorsal cones; lateral longitudinal welts well developed; praesaepium floor formed by depressed venter of T1–T3 and A1; AII strongly projecting ventrally to form lip; AII–AIV with lateral bosses; A1–AVIII with a pair of transverse welts meeting at middorsum, one pair per somite. Leg, wing and gonopod vestiges present. **Spiracles** of thorax small; abdominal large, with rather wide peritreme; atrial walls with minute spinules, varying to hair-like with minute denticles. **Integument** entirely and densely spinulose, spinules large and isolated or minute and in short rows. **Body hairs** minute (about 0.03 mm long), simple, sparse. **Cranium** feebly sclerotized (= yellow); about 2.6 mm wide and 1.7 mm long; subhexagonal or transversely subelliptical in anterior view, with feeble medial impression of occipital border; temporal sulci distinct; ventral border of clypeus straight. Antennae at midlength of cranium, each mounted on a small boss, with 3 sensilla, each bearing a small spinule. Head hairs numerous (about 170), minute (about 0.008 mm long), concentrated on clypeus. **Labrum** small (about 0.8 mm wide and 0.4 mm long), short and bilobed; anterior surface of each half with about 30 minute hairs and/or sensilla, each bearing a spinule; each half of ventral border with about 6 large projecting sensilla and numerous minute spinules; posterior surface with about 8 large sensilla on a sclerotized base. **Mandible** subquadrangular in anterior view; about 0.4 mm wide and 0.77 mm long; medioventral border sclerotized; with a thin subapical blade adjacent to thicker medial blade, both distal to swollen base; numerous papillae at junction of thicker blade and base; a few minute spinules on anterior surface. **Maxilla** with cardo and stipes feebly separated; cardo with about 7 sensilla; integument of stipes spinulose, spinules minute and isolated; palp a short peg with short transverse rugae on integument, apex with 4 sensilla and a denticle; galea a low knob with 2 apical sensilla. **Labium** small; with several lateral sensilla, each bearing a spinule; anteromedial surface with long slender spinules; palp a low boss with 4 apical sensilla and a denticle; an isolated sensillum between each palp and opening of sericteries; the latter wide, transverse and slightly protruding, with numerous minute spinules on lips. **Hypopharynx** spinulose ventrally, spinules minute and isolated; with heavy pigmented ridges dorsally. (Material studied: numerous larvae from Colorado, courtesy of H.E. Evans, and from New Hampshire, collected by G.C. Wheeler.)

Vespula atropilosa (Sladen)

Length (through spiracles) about 21 mm. Similar to *V. maculata* except as follows. Body nearly straight; T1 very short and hidden dorsally; T2 entire and swollen dorsally; T3 feebly divided into anterior and posterior annuli, A1–AIX distinctly divided by middorsal impression; AX with a pair of lateral bosses; anus terminal and with anterior and posterior lips. **Spiracles** with long isolated spinules on atrial wall; atrial opening with numer-

ous spinules bearing denticles at opening of trachea. Integument with isolated spinules. **Body hairs** 0.06–0.25 mm long. **Cranium** about 2.4 mm wide and 1.8 mm long; temporal sulci long and narrow. Head hairs about 0.004 mm long. **Labrum** about 1 mm wide and 0.36 mm long; deeply bilobed; ventral border of each half with about 12 sensilla and a few rather long spinules in arcuate rows; posterior surface of each half with a cluster of about 6 sensilla dorsally and 9 ventrally and with isolated patches of spinules laterally and medially. **Mandible** about 0.42 mm wide and 0.79 mm long; apical tooth nearly uniformly slender, subapical tooth stouter, basal stoutest; blade bearing minute denticles basally and rows of minute spinules ventrally. **Maxilla** with about 25 hairs (about 0.005 mm long); palp with 3–4 apical sensilla. **Labium** with palp a short stout peg bearing 5 apical sensilla. (Material studied: six larvae from Colorado, courtesy of H.E. Evans.)

Vespula maculifrons (Buysson)

Length (through spiracles) about 19 mm. Similar to *V. maculata* except as follows. Body with prominent ventrolateral bosses on AII–AV; AX long and turned ventrally and with a single large dorsal boss. **Spiracles** of metathorax smaller than remainder, which are subequal. Body hairs more numerous on venter of AI. **Cranium** not sclerotized (= same color as body); about 2.2 mm wide and 1.66 mm long; temporal sulci more heavily sclerotized. Antennae at lower third of cranium. Head hairs about 200 and shorter (about 0.003 mm long). **Labrum** about 0.78 mm wide and 0.24 mm long; hairs on anterior surface 0.006–0.012 mm long; ventral border with about 12 sensilla and with minute spinules in short rows medially; posterior surface with 30–36 sensilla. **Mandible** about 0.3 mm wide and 0.7 mm long; anterior surface of teeth roughened with minute isolated denticles; posterior surface roughened with numerous minute bosses near base of blade. **Maxilla** with cardo sclerotized (= pigmented); anterior surface with about 20 minute (about 0.006 mm long) hairs and/or sensilla; stipes rugulose; palp a stout peg with 5 apical sensilla; galea with 2–4 apical sensilla. **Labium** with palp a small boss bearing 3 apical sensilla. (Material studied: four larvae from Michigan, courtesy of R.O. Schuster.)

Vespula pennsylvanica (Saussure)⁴

Length (through spiracles) about 14 mm. Similar to *V. maculata* except as follows. Body with paired dorsal bosses on AI–AVII only. **Body hairs** 0.005–0.025 mm long. **Cranium** about 2 mm wide and 1.6 mm long. **Labrum** with short rows of minute spinules near entire ventral border of anterior surface; posterior surface with spinules in short arcuate rows, except those near middle sulcus coarse and isolated. **Mandible** about 0.3 mm wide and 0.69 mm long; with medial and apical teeth covered on all surfaces with small bosses; posterior surface of proximal portion with minute spinules in short transverse rows. **Maxilla** with about 24 minute hairs (about 0.005 mm long); palp with about 5 apical sensilla; galea a slender tall cone. **Labium** with short rows of minute spinules on anterior surface. **Hypopharynx** with short transverse rows of minute spinules. (Material studied: 13 larvae from California, courtesy of R.O. Schuster.)

SPHECOIDEA
SPHECIFORMES
SPHECIDAE: PEMPHREDONINAE
Microstigmus comes Krombein

Figure 16

Length (through spiracles) about 4 mm. Slender, fusiform and slightly sigmoid; widest at AI, tapering slightly toward anterior end and more toward posterior end; AX with prominent postero-dorsal cone; anus terminal; head large. [Material inadequate to show leg, wing and gonopod vestiges.] Thirteen differentiated somites. **Spiracles** simple, small and decreasing in diameter posteriorly, on T2, T3 and AI–AVII. Entire **integument** with minute isolated spinules; minutely rugose, rugulae closely spaced and longitudinal on ventral surface, irregular elsewhere—but always fine. **Body hairs** very few, widely scattered, minute (about 0.012 mm long) and simple. **Cranium** transversely subelliptical (about 0.45 mm wide and 0.038 mm long); no temporal sulci; clypeus projecting anteriorly and overhanging labrum. Each antenna a slender peg with 2 or 3 sensilla, mounted on a large circular disc, at lower third of cranium. No head hairs. **Labrum** crescentic; anterior surface with a few scattered sensilla, each bearing a spinule; spinules few and isolated anteriorly, minute and in short rows laterally and posteriorly. **Mandible** subtriangular in anterior view; with an apical and 2 subapical teeth, all heavily sclerotized; width increasing abruptly dorsal to basal tooth, wider portion bearing about 6 slender sharp-pointed spinules which are directed ventrally. **Maxilla** large and swollen; entire integument sparsely spinulose, spinules all minute, some isolated and others in short rows, rows longitudinal medially and transverse anteriorly; palp a small slender frustum with 2 apical and 2 subapical sensilla; galea represented by an isolated sensillum. **Labium** with minute isolated spinules; palp similar to maxillary palp in size, shape and sensilla; an isolated sensillum between each palp and opening of sericteries; the latter a narrow transverse slit on anterior surface of labium. **Hypopharynx** with numerous subparallel transverse fine ridges (rows of spinules?). [Material studied: two torn integuments and a slightly shriveled semipupa (?) from Costa Rica (see Evans and Matthews, Psyche 75:132–134); material loaned by National Museum of Natural History, Smithsonian Institution, courtesy of Dr. D.R. Davis.]

It does not seem worth while revising our Key to the Larvae of Social Hymenoptera to accommodate one species. If one wishes to add it before more social sphecoids are known, we suggest:

- 1c. Larvae reared in separate cells; hairs few and minute; temporal sulci absent; antennae at lower third of cranium *Microstigmus comes*

⁴We cannot understand why entomologists persist in using the misspelling *pennsylvanica* for the name of this species. Obviously it is the Latinized adjective for the name of the state of Pennsylvania. We have found the names of 15 other species of Hymenoptera that were correctly spelled *pennsylvanicus* (–a, –um). Why embalm an error in the literature?

APIFORMES

(exclusive of allodapoids)

Body profile stout and crescentic; diameter greatest at AIV and AV, gradually attenuated toward either end. Hairs none or sparse and simple. Mandibles small and usually bearing small denticles.

HALICTIDAE: HALICTINAE

Lasioglossum imitatum (Smith)

Figure 9

Length (through spiracles) about 7.5 mm. Body subcrescentic; diameter greatest at AI; anterior and posterior ends almost meeting; head and anus terminal; anus without lips; head large; lateral longitudinal welts well developed; T2–AVIII each with a pair of transverse welts extending from the longitudinal welts to mid-dorsum, smaller on AIX and AX, reduced to low bosses on dorsum of T1. Wing and leg vestiges present. **Spiracles** rather large; peritreme very narrow and feebly sclerotized; atrium with rows of encircling spinules. **Integument** on dorsal and ventral surfaces with minute spinules isolated or in short rows. No **body hairs** seen. **Cranium** feebly sclerotized (= light yellow); feebly cordate in anterior view; about 0.86 mm wide and 0.63 mm long; temporal sulci short. Each antenna a small boss with 2 or 3 sensilla, each sensillum mounted on an elevated disc. No head hairs seen. **Labrum** small; about 0.28 mm wide and 0.13 mm long; feebly bilobed; anterior surface with a few short transverse rows of minute spinules; anterolateral surfaces with a few ridges; lateral and ventral surfaces spinulose; posterior surface densely spinulose, spinules long and in short rows medially, larger and isolated laterally. **Mandible** small and stout; about 0.15 mm wide and 0.24 mm long; apex heavily sclerotized; basal half subrectangular, apical half subtriangular, sharp-pointed, with a medial blade bearing a few medial denticles. **Maxilla** paraboloidal, anterior and medial surfaces of cardo with reticulate ridges and with rather large isolated spinules; apex with short transverse rows of minute spinules; palp represented by 5 isolated sensilla; galea represented by 2 apical sensilla. **Labium** small; palp represented by a few scattered sensilla; an isolated sensillum between each palp and opening of sericteries; the latter a short transverse slit. **Hypopharynx** with coarse isolated spinules. (Material studied: five larvae from Kansas, courtesy of C.D. Michener.)

Lasioglossum sp.

Figure 10

Length (through spiracles) about 14.7 mm. Similar to *L. imitatum* except as follows. Body with welts on dorsal and lateral surfaces and venter of AIX more distinct. **Integument** with numerous rugulae in varied patterns; spinulose, spinules coarse and isolated or finer and in short transverse rows. **Cranium** about 1.4 mm wide and 0.78 mm long; feebly cordate. **Labrum** about 4.9 mm wide and 0.25 mm long; subtrapezoidal in anterior view, widest dorsally; posterior surface spinulose, the spinules minute and in short arcuate rows and with about 12 sensilla. **Mandible** about 0.25 mm wide and 0.46 mm long. (Material studied: four larvae from "Wellsville res., Cache Co., Utah, June 1971," coll. P.F. Torchio, courtesy of P.F. Torchio.)

ANTHOPHORIDAE: XYLOCOPINAE

Social allodapoids. Body profile usually J-shaped; anterior end (thorax and first 3 or 4 abdominal somites) stout and strongly curved ventrally; remainder straight and elongate-subconical; tapering to a pointed posterior end; with one or a pair of projections on dorsum of thorax and a few abdominal somites. Body hairs short to long and sparse to abundant; head hairs, when present, sparse but remarkably long. Mandibles small.

Braunsapis facialis (Gerstaecker)

Figure 11

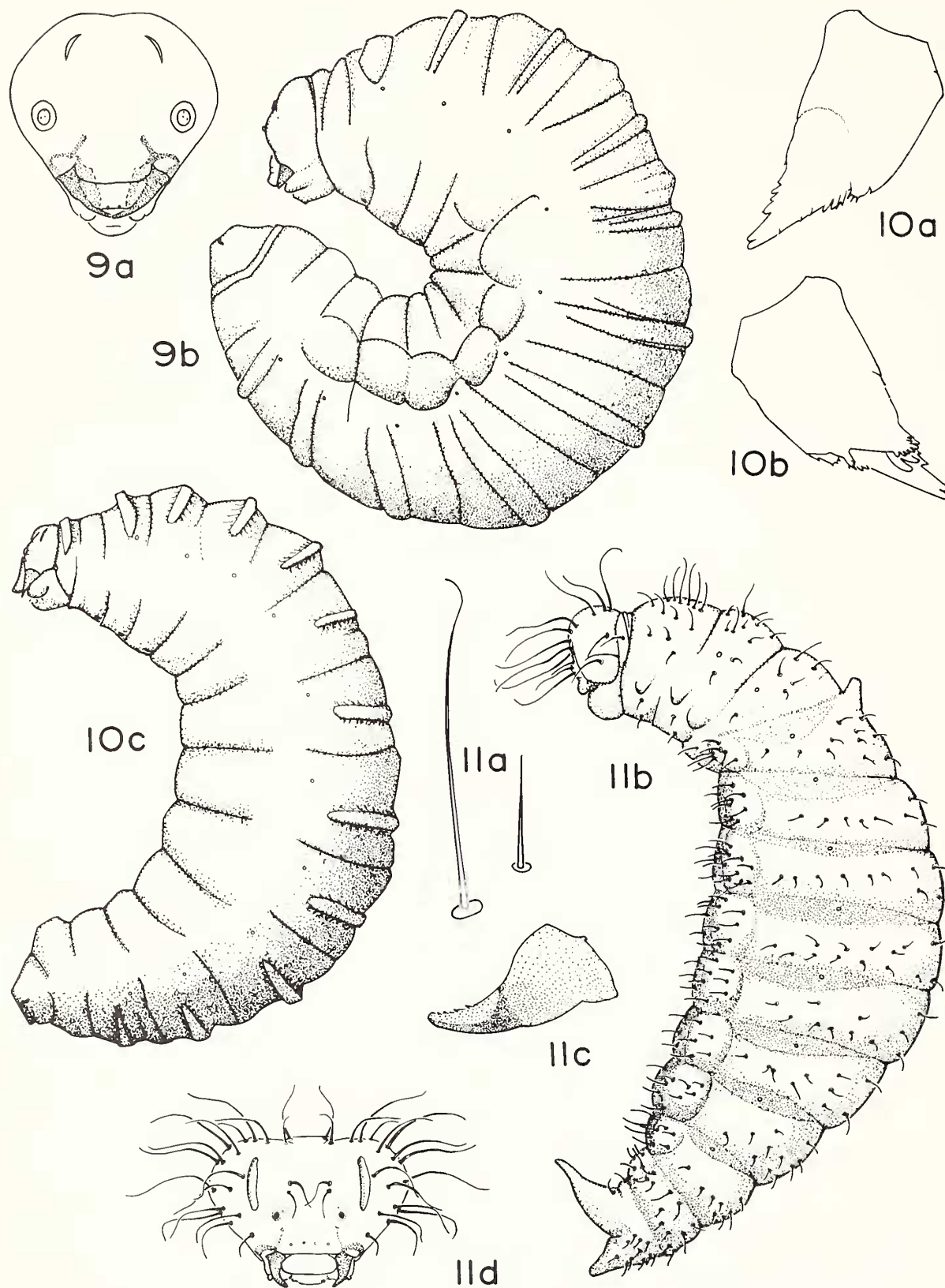
Length (through spiracles) about 5.4 mm. Body subcrescentic; diameter greatest at AIV, attenuating toward either end; dorsal profile long and C-shaped, ventral profile angulate; ventral surface flat to concave; lateral longitudinal welts well developed, forming small cones on T2, T3 and AI; a middorsal boss on AI; praesaepium with permanent bosses projecting ventrally from each lateral surface of T2, T3, and AI; AII forming ventral wall. Anus terminal, with a long subconical ventral lip and a short conical dorsal lip. Leg and gonopod vestiges present. **Spiracles** with peritreme narrow and lightly sclerotized, atrial wall with a few encircling rugulae. Entire **integument** rugulose and with papillae or spinules; rugulae on venter of thorax transverse and bearing minute spinules; integument around spiracles with numerous large granules. **Body hairs** few, simple, 0.025–0.15 mm long, short and spike-like to long with flexuous tip. **Cranium** not sclerotized (= same color as body); about 0.96 mm wide and 0.54 mm long; subcordate, sharply narrowed ventrally; temporal sulci conspicuous, rather wide and vertical. Antennae at lower third of cranium; each mounted on a small base, a slight elevation with 3 sensilla. Head hairs few (about 40), about 0.008 mm long on clypeus near labrum, long (0.125–0.6 mm) elsewhere and with fine flexuous tip. **Labrum** transversely subelliptical, about 0.35 mm wide and 0.12 mm long; with raised transversely elliptical and feebly sclerotized (= yellow) portion ventrally; anterior surface with about 20 hairs and with minute spinules dorsally; ventral surface with minute spinules in short transverse rows; posterior surface with about 4 sensilla and rows of minute spinules. **Mandible** small (about 0.1 mm wide and 0.18 mm long); feebly sclerotized; subtriangular in anterior view; apex narrowly round-pointed and directed medially; apical half with medial blade bearing a few minute denticles near apex. **Maxilla** small and appearing adnate, apex broadly round-pointed; with a few transverse rows of minute spinules on medial and posterior surfaces; palp represented by a cluster of 5 or 6 sensilla; galea apparently lacking. **Labium** small; with a basal transverse spinulose welt; anterior surface with a few transverse rows of minute spinules; palp represented by a cluster of 5 sensilla; an isolated sensillum between each palp and opening of sericteries; the latter an inconspicuous transverse slit. (Material studied: five larvae from Natal, courtesy of C.D. Michener.)

APIDAE: BOMBINAE

Bombus bimaculatus Cresson

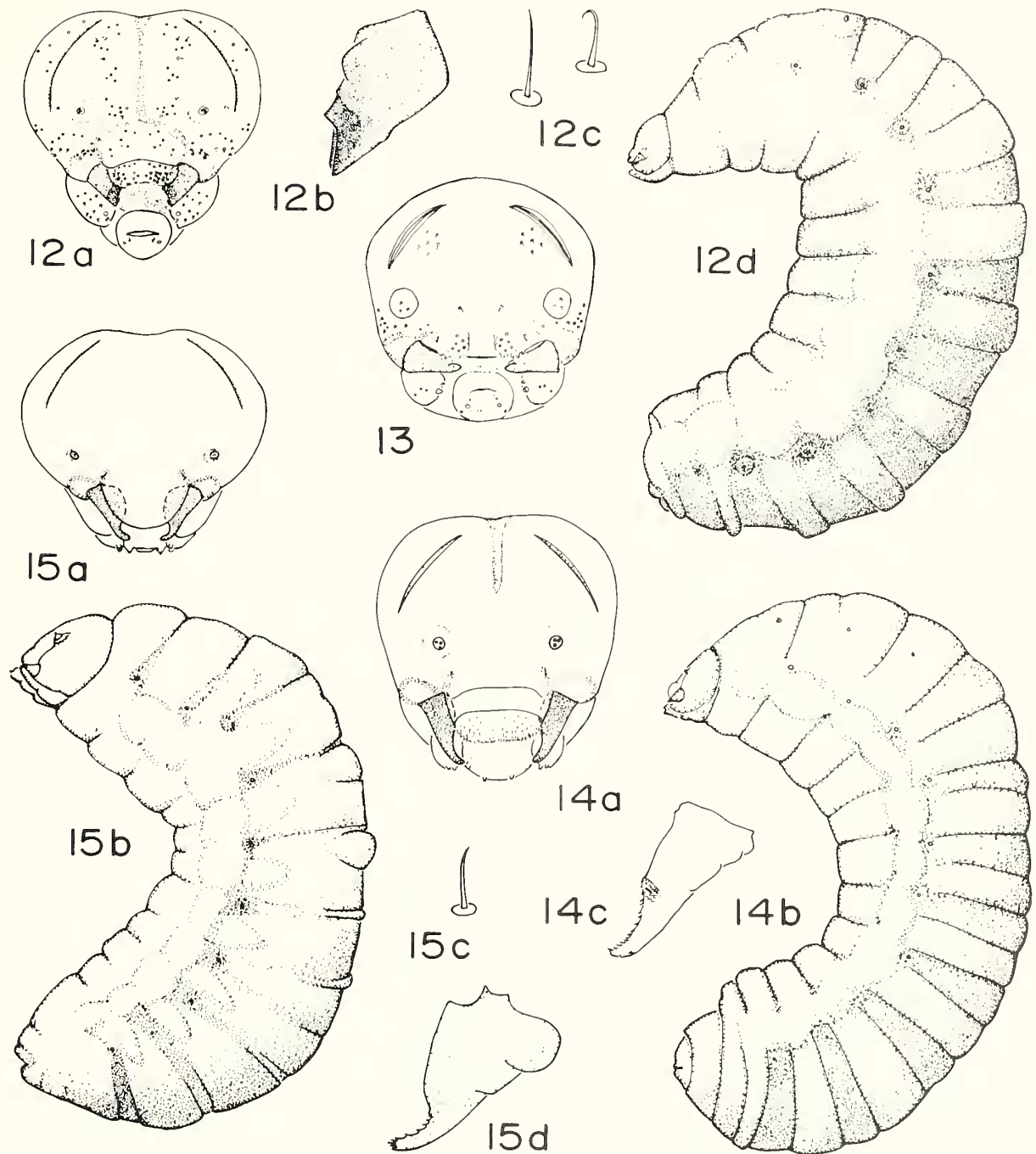
Figure 12

Length (through spiracles) about 19 mm. Body subcrescentic;



FIGURES 9 THROUGH 11.

FIGURE 9. *Lasioglossum imitatum*. a, Head in anterior view, X42; b, larva in side view, X24. FIGURE 10. *Lasioglossum* sp. a, Left mandible in anterior view, X98; b, left mandible in posterior view, X98; c, larva in side view, X10. FIGURE 11. *Braunsapis facialis*. a, Two body hairs, X135; b, larva in side view, X25; c, left mandible in anterior view, X88; d, head in anterior view, X35.



FIGURES 12 THROUGH 15.

FIGURE 12. *Bombus bimaculatus*. a, Head in anterior view, X24; b, left mandible in anterior view, X76; c, two body hairs, X400; d, larva in side view, X7. FIGURE 13. *Apis mellifera*. Head in anterior view, X30. FIGURE 14. *Melipona fasciata trinitatis*. a, Head in anterior view, X78; b, larva in side view, X9; c, left mandible in anterior view, X76. FIGURE 15. *Trigona japy*. a, Head in anterior view, X49; b, larva in side view, X22; c, body hair, X834; d, left mandible in anterior view, X150.

dorsal profile long and C-shaped; ventral profile shorter and J-shaped; lateral longitudinal welts well developed; thoracic somites each with a pair of mammiform bosses on the dorsum, their tips acute and sclerotized; posterior portion of each abdominal somite with a transverse welt from spiracle to middorsum. Transitory praesaepium floor formed from the ventral depression of thoracic somites and AI; venter of AII forms cover. Leg and gonopod vestiges present. Area around each spiracle depressed;

peritreme narrow and feebly sclerotized; atrial wall lined with rings of long spinules, some simple and some denticulate. Entire integument with large isolated spinules grading into minute spinules posteriorly; integument roughened with numerous rugulae. **Body hairs** sparse, about 0.038 mm long, varying from slender and slightly curved to stout and hooked. **Cranium** not sclerotized (= same color as body); subcordate in anterior view, about 1.68 mm wide and 1.13 mm long; temporal sulci conspic-

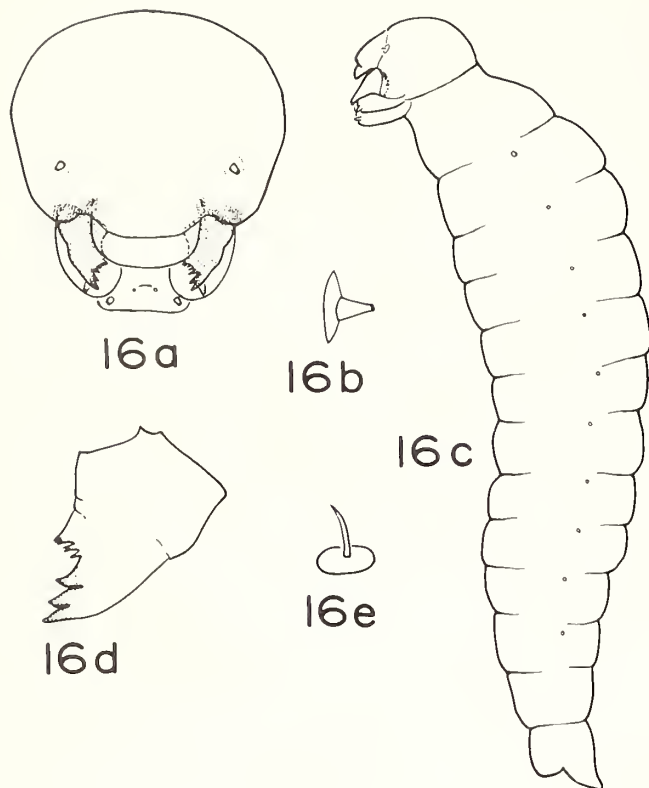


FIGURE 16. *Microstigmus comes*. a, Head in anterior view (reconstruction), X76; b, right antenna in lateral view, X200; c, larva in side view (reconstruction), X30; d, left mandible in anterior view, X200; e, body hair, X625.

uous. Each antenna mounted on a large circular base; a small slightly sclerotized peg with 3 apical sensilla. Head hairs numerous (about 150), short (about 0.013 mm long), simple, slender and slightly curved. **Labrum** small (about 0.44 mm wide and 0.2 mm long), bilobed; each half of anterior surface with about 40 hairs (up to 0.013 mm long) and with sensilla, each of which bears a minute spinule; each half of ventral surface with minute spinules in short rows medially and dorsally, large and isolated ventrally and laterally. **Mandible** small (about 0.2 mm wide and 0.4 mm long); apex the most heavily sclerotized portion of entire larva; subtrapezoidal in anterior view; apex blunt; ventromedial border concave and furnished with both an anterior and a posterior blade; anterior blade with papillae on border and with a few rugae on surface. **Maxilla** with apex narrowly round-pointed; cardo with numerous minute spinules, isolated or in short rows; stipes with about 30 simple hairs, 0.013–0.025 mm long; with rows of minute spinules basally and laterally, spinules longer and isolated medially and apically; palp a small frustum with 3 apical sensilla; galea apparently lacking. **Labium** small and rounded; with rugae on anterior surface, short and numerous basally, longer and more widely spaced ventrally; palp a slender frustum with 3 apical sensilla; an isolated hair about 0.02 mm long between each palp and opening of sericteries; the latter wide and salient. **Hypopharynx** spinulose, spinules minute and in short rows basally, long and isolated ventrally. (Material studied: 4 larvae from New Jersey, courtesy of J.G. Rozen.)

Bombus occidentalis nigroscutatus Franklin

Length (through spiracles) about 15.4 mm. Similar to *B. bimaculatus* except as follows. Body forming a nearly complete circle; dorsal profile very long and C-shaped, ventral V-shaped; middle portion of T1–T3 with a pair of transverse welts meeting at middorsum, one pair per somite. Integument of dorsal and lateral surfaces with numerous large isolated spinules, ventral with numerous subparallel ridges bearing minute spinules; no spinules around spiracles. **Body hairs** shorter (about 0.005 mm long). **Cranium** feebly sclerotized (= yellow) and transversely sub-elliptical; about 1.68 mm wide and 1.2 mm long. **Labrum** about 0.45 mm wide and 0.115 mm long; each half of anterior surface with about 30 hairs about 0.006 mm long. **Mandible** about 0.3 mm wide and 0.45 mm long; apex broadly and heavily sclerotized; no blade seen. **Maxilla** with basal portion ventral and apex directed dorsomedially; hairs all about 0.013 mm long; palp with 5 apical sensilla; galea represented by a single hair about 0.19 mm long. **Labium** with minute spinules in short arcuate rows on anterior surface, rows transverse; palp with 5 apical sensilla; 2 hairs about 0.013 mm long medial to each palp. **Hypopharynx** with minute spinules in transverse rows dorsally, laterally with ends curved ventrally. (Material studied: two larvae from California, courtesy of R.O. Schuster.)

APIDAE: APINAE

Apis mellifera Linnaeus

Figure 13

Length (through spiracles) about 14 mm. Body subcrenate; diameter greatest at AVIII; posterior end narrowly round-pointed; anterior end nearly sharp-pointed; lateral longitudinal welts on T2–AX and a pair of transverse welts on each somite T2–AVI, meeting at middorsum, one pair per somite. Leg, wing and gonopod vestiges present. Somites indistinct. **Spiracles** with narrow peritreme and a simple atrial wall. **Integument** densely spinulose, spinules minute and in short rows or large and isolated. **Body hairs** few, about 0.013 mm long, simple. **Cranium** sub-pentagonal; about 1.6 mm wide and 1.2 mm long; no portion sclerotized (= same color as body); temporal sulci conspicuous (wide); integument with numerous denticles or papillae. Antennae very large; on lower third of cranium; each with 3 sensilla. Head hairs few (about 24); 0.006–0.013 mm long; simple. **Labrum** about 0.49 mm wide and 0.24 mm long; integument roughened as on cranium; each half of anterior surface with about 12 sensilla, each with a minute spinule; with spinules on and near ventral and lateral surfaces, spinules long and slender; posterior surface spinulose, spinules longer and in rows ventrally and laterally. **Mandible** about 0.19 mm wide and 0.9 mm long; elongate-lobose and slightly curved medially in anterior view; apex with blunt denticles directed medially. **Maxilla** with apex narrowly round-pointed; entire integument with short transverse rows of minute spinules and a few sensilla each with a long spinule; palp a short subcone with 5 (2 apical, 2 subapical and 1 lateral) sensilla; galea a rounded knob with 2 sensilla, each bearing a spinule. **Labium** subcircular; anterior surface sparsely spinulose, spinules in rows, rows longer ventrally; palp a short peg with 2 apical sensilla, each with a small rounded medial protuberance; an isolated sensillum between each palp and opening of sericteries, the latter wide and salient, lips with ridges radiat-

ing to free border. **Hypopharynx** with a few minute spinules in short arcuate rows, rows arranged into longer transverse subparallel rows. (Material studied: numerous larvae from California, courtesy of S.I. Frommer.)

APIDAE: MELIPONINAE
Melipona fasciata trinitatis Cockerell

Figure 14

Length (through spiracles) about 13 mm. Body subrescenscent; posterior end more rounded than anterior; lateral longitudinal welts well developed; ventral swellings on AI–AIX; a pair of transverse welts from spiracle to middorsum on T1–AVIII, one pair per somite; AIX with welt across dorsum. Anus terminal and with ventral lip. No praesaepium. **Spiracles** with minute spinules on free edge of peritreme; walls of atrium with minute spinules in transverse rows. **Integument** largely spinulose, spinules isolated and rather large or in short rows and smaller. **Body hairs** minute (about 0.006 mm long), simple and very slender. **Cranium** feebly sclerotized (= yellow); about 1.44 mm wide and 0.88 mm long; feebly subcordate; temporal sulci distinct; integument rugulose; some rugae with minute spinules; clypeus with about 18 hairs near labrum. Antennae small; at lower third of cranium; each on a slightly raised boss; each with 3–5 sensilla, each of which bears a minute spinule. **Labrum** about 0.34 mm wide and 0.29 mm long; feebly bilobed; anterior surface of each half with numerous long isolated spinules and 12 sensilla; ventral and lateral surfaces with numerous spinules in short rows, more numerous ventrally; middle of ventral border of each half with prominent projecting sensilla; entire posterior surface spinulose, spinules minute and in transverse arcuate rows; posterior surface with sensilla. **Mandible** small, about 0.2 mm wide and 0.4 mm long; feebly sclerotized; subtriangular in anterior view, with apex round-pointed and curved medially; apical half with medial blade and numerous denticles; base with minute isolated spinules on anterior surface. **Maxilla** with numerous rather large isolated spinules on cardo; stipes narrowly round-pointed and spinulose, spinules rather long and in arcuate rows arranged longitudinally; palp and galea subequal; palp a low knob with 4 apical sensilla, each bearing a spinule; galea a low knob with 2 apical sensilla. **Labium** with long subparallel transverse ridges bearing spinules;

palp a low knob with 4 or 5 sensilla; an isolated sensillum between each palp and opening of sericteries; the latter wide and salient. (Material studied: one larvae and three semipupae from Trinidad, courtesy of J.G. Rozen.)

Trigona jaty Smith

Figure 15

Length (through spiracles) about 5.5 mm. Body subrescenscent; head and anus terminal; lateral longitudinal welts well developed; AII and AIII with a pair of bosses each, which meet at mid-dorsum; smaller structures on AIV and AV. Venter flattened. Head large. Leg, wing and gonopod vestiges present. **Spiracles** with wide, feebly sclerotized peritreme; atrial wall with a few simple ridges. **Integument** entirely spinulose, spinules large and isolated on dorsal ridges above spiracles, elsewhere minute and in rows. **Body hairs** few, simple and minute (about 0.12 mm long). **Cranium** not sclerotized (= same color as body); about 0.9 mm wide and 0.6 mm long; subcordate in anterior view; temporal sulci short and narrow. Antennae at lower third of cranium; each set on a raised base; a small elevation with 3 sensilla, each bearing a minute spinule. Head hairs few (about 10), about 0.012 mm long, simple and slender. **Labrum** semicircular in anterior view, about 0.29 mm wide and 0.15 mm long; entire anterior surface spinulose, spinules short and in transverse rows; anterior surface with about 25 raised sensilla; rather long isolated spinules on ventral and lateral surfaces; posterior surface with minute spinules in short transverse rows. **Mandible** small and stout (about 0.14 mm wide and 0.2 mm long); feebly sclerotized; subtriangular in anterior view; apex round-pointed and curved medially, with spinulose margin; a few minute spinules on anterior surface near base. **Maxilla** slightly inflated; apex bluntly rounded; spinulose, spinules longer and isolated apically, shorter and in rows basally; palp a short knob with 3 apical sensilla; galea represented by 2 sensilla, each bearing a rather long spinule. **Labium** small; sparsely spinulose, spinules minute and isolated; palp a short knob; an isolated sensillum between each palp and opening of sericteries, the latter wide and salient. **Hypopharynx** with minute spinules in long subparallel transverse rows. (Material studied: numerous larvae from Panamá, courtesy of P.F. Torchio.)

LIST OF SPECIES WHOSE LARVAE ARE DESCRIBED AND/OR ILLUSTRATED IN THE LITERATURE⁵

SUPERFAMILY VESPOIDEA FAMILY VESPIDAE SUBFAMILY POLISTINAE

Apoica

- flavissima* van der Vecht. Dias 1975: 3, fig. 16–23.
pallens (Fabricius). Dias 1975: 3, fig. 9–15; this paper.

Belonogaster

- lateritius* Gerstaecker. Wheeler and Wheeler 1979: 313, fig. 13h;
this paper.

Brachygastra

- augusti* (Saussure). Dias 1975: 9, fig. 175–180.
lecheguana (Latreille). Dias 1975: 9, fig. 165–174.
scutellaris (Fabricius). Reid 1942: 314, fig. 99–103.

Metapolybia

- cingulata* (Fabricius). Reid 1942: 317, fig. 109–113.

Mischocyttarus

- araujoi* Zikán. Dias 1975: 6, fig. 68–73, 85.
carbonarius (Saussure). Reid 1942: 323, fig. 118–119.
cassununga (von Ihering). Dias 1975: 5, fig. 51, 58–67.
cerebrus acheron Richards. Reid 1942: 322, fig. 124–126, 129.
c. styx Richards. Dias 1975: 5, fig. 45–50, 52–54, 57.
collarellus Richards. Reid 1942: 324, fig. 131.
drewseni Saussure. Dias 1975: 4, fig. 24–33, 55, 56.
flavitaris (Saussure). This paper.
injucundus (Saussure). Reid 1942: 326, fig. 133, 134.
laticus (Fox). Dias 1975: 6, fig. 74–84.
lecointei (Ducke). Reid 1942: 320, fig. 115, 123, 128.
metoecus Richards. Reid 1942: 321, fig. 117, 122.
oecothrix Richards. Reid 1942: 323, fig. 114, 121.
roundicollis (Cameron). Dias 1975: 4, fig. 34–44.
superus Richards. Reid 1942: 325, fig. 132.
surinamensis (Saussure). Reid 1942: 325, fig. 127.
synoecus Richards. Reid 1942: 323.
sp. Reid 1942: 325, fig. 135–137.

Parachartergus

- fraternus* (Gribodo). Dias 1975: 7, fig. 98–104.
pseudoapicalis (Fabricius). Dias 1975: 6, fig. 90–97.

Polistes

- annularis* (Linnaeus). Nelson 1969: 31.
apachus Saussure. Nelson 1969: 37.
biglumis (Linnaeus). Yamane 1976: 10, fig. 8–11.
canadensis (Linnaeus). Dias 1975: 11, fig. 228–238.
carnifex (Fabricius). Reid 1942: 300, fig. 43–51; Nelson 1969: 88.
cinctus (Lepeletier). Packard 1897: 77–79, fig. 6; Reid 1942: 304.
cinerascens Saussure. Dias 1975: 11, fig. 239–247.
comanchus Saussure. Nelson 1969: 42.
crinitus multicolor (Olivier). Reid 1942: 303, fig. 52–62.
dorsalis (Fabricius) (= *hunteri* Bequaert). Nelson 1969: 69.
erythrocephalus Latreille. Nelson 1969: 92; this paper.
exclamans Viereck. Nelson 1969: 47; this paper.

e. lineonotus R. Bohart. This paper.

flavus Cresson. Nelson 1969: 52.

foederatus Kohl. Grandi 1934a: 74–78, pl. 1, II; Grandi 1934b:
9–16, fig. V–X; Reid 1942: 304–305, fig. 63–66.

fuscatus (Fabricius). This paper.

f. aurifer Saussure. Nelson 1969: 56; this paper.

f. centralis Hayward. Nelson 1969: 60.

f. variatus Cresson. Nelson 1969: 65.

gallicus (Linnaeus). Parker 1943: 619–620, fig. 1–5; Reid 1942:
305–306, fig. 67–68; Soika 1934: 340, 10 fig.

kohli Dalla Torre. Grandi 1934a: 74–78, pl. I.

major castaneicolor Bequaert. This paper.

metricus Say. Nelson 1969: 74.

poeyi Lepeletier. This paper.

rohnei iwatai van der Vecht. Yamane 1976: 10, fig. 12.

rubiginosus Lepeletier. Nelson 1969: 79.

simillimus Zikán. Dias 1975: 1, fig. 221–227.

versicolor (Olivier). Dias 1975: fig. 211–220; Nelson 1969: 100.
sp. Yamane 1976: fig. 13.

Polybia

bistriata (Fabricius). Reid 1942: 310, fig. 86–89.

catillifex Moebius. Reid 1942: 310, fig. 82–85.

clrysorthorax (Weber). Dias 1975: 8, fig. 145–151.

dimidiata (Olivier). Dias 1975: 8, fig. 152–157.

fastidiosuscula Saussure. Dias 1975: 8, fig. 131–137.

ignobilis (Haliday). Dias 1975: 8, fig. 138–144.

jurinei Saussure. Dias 1975: 7, fig. 125–130.

micans Ducke. Reid 1942: 308, fig. 69–77.

occidentalis (Olivier). Dias 1975: 7, fig. 105–112; this paper.

paulista (von Ihering). Dias 1975: 7, fig. 113–120.

rejecta (Fabricius). Reid 1942: 309, fig. 78–81.

scutellaris (White). Dias 1975: 7, fig. 121–124.

Protonectarina

sylveirae (Saussure). Dias 1975: 8, fig. 158–164.

Protopolybia

exigua (Saussure). Dias 1975: 9, fig. 181–187.

minutissima (Spinola). Reid 1942: 312, fig. 90–93.

pumila (Saussure). Dias 1975: 9, fig. 188–194.

sedula (Saussure). Reid 1942: 312, fig. 94–98.

Ropalidia

cincta (Lepeletier). This paper.

Stelopolybia

infernalis (Saussure). Reid 1942: 316, fig. 104–108.

meridionalis von Ihering. Dias 1975: 10, fig. 195–201.

pallipes (Olivier). Dias 1975: 10, fig. 202–210

Syneoca

surinama (Fabricius). Wheeler and Wheeler 1979: 313, fig. 13i;
this paper.

s. cyanea (Fabricius). Dias 1975: 6, fig. 86–89.

⁵ Social parasites are included.

SUBFAMILY VESPINAE

Vespa

- affinis* Linnaeus. Yamane 1976: fig. 29, 37, 41.
analis insularis Dalla Torre. Yamane 1976: fig. 28, 42, 49, 54b, 59.
a. nigrans Buysson. Yamane 1976.
basalis Smith. Yamane 1976: fig. 36, 61.
crabro Linnaeus. Reid 1942: 296, fig. 37–41.
c. flavofasciata Cameron. Yamane 1976: fig. 44, 54a, 58.
mandarina latilineata Cameron. Yamane 1976: fig. 53.
m. nobilis Sonan. Yamane 1976: fig. 14–16, 18–21, 53.
simillima Smith. Yamane 1976: fig. 45.
tropica pseudosoror van der Vecht. Yamane 1976: fig. 44, 60.
velutina flavitaris Sonan. Yamane 1976: fig. 17.
xanthoptera Cameron. Yamane 1976.

Vespula

- arenaria* (Fabricius). Packard 1897: 80.
atropilosa (Sladen). Wheeler and Wheeler 1979: 313, fig. 13g; this paper.
germanica (Fabricius). Grandi 1935: 31; Reid 1942: 296, fig. 32–35; Soika 1934: 340, 11 fig.
karenkona Sonan. Yamane 1976: fig. 63.
lewisi Cameron. Yamane 1976.
media (DeGeer). Reid 1942: fig. 30–35; Yamane 1976: fig. 25, 38, 47, 52, 57.
maculata (Linnaeus). Wheeler and Wheeler 1979: 306, fig. 10b, 313, 13f; this paper.
maculifrons (Buysson). This paper.
norvegica (Fabricius). Grandi 1934a: 74–78, pl. I–II; Grandi 1934b: 17–23, fig. XI–XVI; Reid 1942: 296, fig. 32–35.
pennsylvanica (Saussure). This paper.
rufa (Linnaeus). Grandi 1934a: 74–78, pl. I; Grandi 1935: 29–31, fig. I, II; Reid 1942: 296, fig. 29–31; Yamane 1976.
r. schrenckii Radoszkowsky. Yamane 1976: fig. 56, 64.
saxonica nipponica Sk. Yamane. Yamane 1976: fig. 24, 48, 51, 65.
silvestris Scopoli. Grandi 1934a: 74–78, pl. I.
vulgaris (Linnaeus). Reid 1942: 294, fig. 19–28, 42; Yamane 1976: fig. 22, 23, 39, 50, 55.

SUPERFAMILY SPHECOIDEA

FAMILY SPHECIDAE

SUBFAMILY PEMPHREDONINAE

Microstigmus

- comes* Krombein. Evans and Matthews 1968: 132–134; this paper.

FAMILY HALICTIDAE

SUBFAMILY HALICTINAE

TRIBE HALICTINI

Lasioglossum

- imitatum* (Smith). This paper.
 sp. This paper.

FAMILY ANTHOPHORIDAE

SUBFAMILY XYLOCOPINAE

TRIBE ALLODAPINI

Allodapula

- acutigera* Cockerell. Michener 1975: 246, fig. 2–4, 14, 15.
dichroa (Strand). Michener 1975: 248–249.
hessei Michener. Michener 1975: 248, fig. 1, 12, 13.
melanopus (Cameron). Michener 1975: 249, fig. 5, 6, 18, 19.
ornaticeps Michener. Michener 1975: 249, fig. 8, 9, 20, 21.

Braunsapis

- acuticauda* Michener. Michener 1975: 238.
albitarsis (Friese). Michener 1975: 234.
bouyssoui Vachal. Michener 1975: 232, fig. 15–19.
draconis Michener. Michener 1975: 234, fig. 45–51.
elizabethana (Strand). Michener 1975: 237, fig. 66, 82–90.
facialis (Gerstaecker). Michener 1975: 229, fig. 1–8, 27–30; Wheeler and Wheeler 1979: 299, fig. 6, 306, fig. 10c, 313, fig. 13e; this paper.
foveata (Smith). Michener 1975: 240, fig. 101–113.
ghanae Michener. Michener 1975: 236, fig. 79–81.
gorillarum (Cockerell). Michener 1975: 231, fig. 14.
leptozenia (Vachal). Michener 1975: 233, fig. 24–26, 31–44.
luapulana (Cockerell). Michener 1975: 234, fig. 52–58, 62–65.
natalica Michener. Michener 1975: 231, fig. 9–13.
pallida Michener. Michener 1975: 231.
paradoxa (Strand). Michener 1975: 238, fig. 67–68, 91–97.
rhodesi (Cockerell). Michener 1975: 236, fig. 59–61.
rolini (Vachal). Michener 1975: 232, fig. 20.
simplicipes Michener. Michener 1975: 232, fig. 21–23.
stuckenbergerorum Michener. Michener 1975: 236, fig. 72–78.
trochanterata (Gerstaecker). Michener 1975: 240, fig. 69, 70, 114–118.
vitrea (Vachal). Michener 1975: 238, fig. 98–100.

Eucondylops

- konowi* Brauns. Michener 1975: 249, fig. 10, 11, 22, 23.

Exoneura

- concinula* Cockerell. Syed 1963: 269, 271, fig. 33–37.
hamulata Cockerell. Syed 1963: 268–269, fig. 20–32.
obscuripes Michener. Syed 1963: 271–272, fig. 44–49.
subbaculifera Rayment. Syed 1963: 273, fig. 50–52.
variabilis Rayment. Syed 1963: 266–268, fig. 1–19.

Inquilina

- excavata* (Cockerell). Syed 1963: 273, 274, fig. 38–43.

Nasutapis

- strausorum* Michener. Michener 1975: 242, fig. 71, 119–123.

FAMILY APIDAE

SUBFAMILY BOMBINAE

Bombus

- agrorum pascuorum* Scopoli. Grandi 1937: 316–320, fig. XXXI–XXXIV.

americanorum Fabricius. Michener 1953: 1087, fig. 248–253; Ritcher 1933: 59, fig. 32, 33.
auricomus Robertson. Ritcher 1933: 59, fig. 1, 4, 10, 14, 15.
bimaculatus Cresson. Ritcher 1933: 59, fig. 2, 5, 7–9, 11, 18, 19; Wheeler and Wheeler 1979: 313, fig. 13d; this paper.
fervidus (Fabricius). Packard 1897: 115; Ritcher 1933: 59, fig. 28, 29.
griseocollis (DeGeer) (= *separatus*). Ritcher 1933: 59, fig. 22.
impatiens Cresson. Ritcher 1933: 59, fig. 16, 17.
melanopygus Nylander. This paper.
occidentalis nigroscutatus Franklin. This paper.
perplexus Cresson. Ritcher 1933: 59, fig. 20, 21.
silvarum (Linnaeus). Grandi 1934b: 112–117, fig. LXXXI–LXXX.
terricola Kirby. Ritcher 1933: 59, fig. 24, 25.
vagens Smith. Packard 1897: 117; Ritcher 1933: 59, fig. 26, 27.
vosnesenskii Radoszkowski. Michener 1953: 1089, fig. 254.

Psithyrus

variabilis (Cresson). Ritcher 1933: 59, fig. 3, 6, 30, 31; Michener 1953: 1090.

SUBFAMILY APINAE

Apis

cerana Fabricius (= *indica*). Torchio and Torchio 1975: 8, 9, fig. 3, 4, 10, 14, 24–26, 35, 42, 46, 51, 55, 61, 71, 76.
dorsata Fabricius. Torchio and Torchio 1975: 10, 11, fig. 7, 8, 12, 16, 29–33, 36, 39, 40, 44, 48, 49, 53, 56, 62, 70, 74, 78.
florea Fabricius. Torchio and Torchio 1975: 9, 10, fig. 5, 6, 11,

15, 27, 28, 37, 43, 47, 52, 57, 63–65, 67, 68, 72, 75.

mellifera Linnaeus. Grandi 1934a: 78, pl. II; Grandi 1934b: 110–112, fig. LXXIV–LXXV; Michener 1953: 1094, fig. 275–280; Nelson 1924: 1167–1170, 5 fig.; Packard 1897: 120; Torchio and Torchio 1975: 4–8, fig. 1, 2, 9, 13, 17–23, 34, 38, 41, 45, 50, 54, 58–60, 66, 69, 73, 77; Wheeler and Wheeler 1979: 306, fig. 10a; 313, fig. 13a; this paper.

SUBFAMILY MELIPONINAE

Lestrimelitta

ehrharti Friese. Oliveira 1968: 9, fig. 1–3.
limao (Smith). Oliveira 1968: 2–6, fig. 1–3.

Melipona

fasciata trinitatis Cockerell. Wheeler and Wheeler 1979: 313, 13b; this paper.
marginata Lepeletier. Michener 1953: 1092, fig. 260–262.
nigra schenski Gribodo. Oliveira 1960: 4–16, 25 fig.
quadrifasciata Lepeletier. Michener 1953: 1090, 1092, fig. 255–259.
variegatipes Gribodo. Michener 1953: 1092, fig. 263–265.

Trigona

corvina Cockerell. Michener 1953: 1094, fig. 271, 272, 274.
cupira Smith. Michener 1953: 1093, 1094, fig. 266–270, 273.
droryana (Friese). Oliveira 1965 (*vide* 1968).
jaty Smith. Wheeler and Wheeler 1979: 313, 13c; this paper.
muelleri (Friese). Oliveira 1970: 235–238, fig. 1–3.

CHARACTERIZATIONS OF LARVAE OF HIGHER TAXA

VESPOIDEA

Vespoidea:—Wheeler and Wheeler 1979: 318–319.
 Vespidae:—Dias 1975: 2, fig. 1–8; Reid 1942: 287–289.
 Vespinae:—Reid 1942: 294; Yamane 1976: 4–9, fig. 1–3.
 Polistinae:—Dias 1975: 3; Reid 1942: 299, 307; Yamane 1976: 10. *Apoica* Dias 1975: 3. *Brachygastra* Dias 1975: 9. *Metapolybia* Reid 1942: 317. *Mischocyttarus* Dias 1975: 3; Reid 1942: 317–318. *Parachartergnus* Dias 1975: 6. *Polistes* Dias 1975: 10; Nelson 1969: 14–28. *Polybia* Dias 1975: 7; Reid 1942: 308. *Protopolybia* Dias 1975: 9; Reid 1942: 311. *Stelopolybia* Dias 1975: 10; Reid 1942: 315–316.

SPHECOIDEA APIFORMES GROUP

Apiformes group (excluding allodipoid bees):—Wheeler and Wheeler 1979: 317–318.
 Xylocopinae:—*Allodapula* and *Eucondylops* Michener 1975: 244. *Braunsapis* and *Nasutapis* Michener 1975: 224–225. Allodipoid bees:—African allodipine bees Michener 1976: 36. Wheeler and Wheeler 1979: 316–317.
 Bombinae:—Ritcher 1933: 54–56.

KEYS TO LARVAE

Families of eusocial Hymenoptera:—Wheeler and Wheeler 1979: 315–316.

VESPOIDEA

Subfamilies of Vespidae:—Reid 1942: 289; Soika 1934: 341.
 Species of *Vespa* and *Vespnla* of Japan and Taiwan, Yamane

1976: 13, 14.

Certain species of *Polistes* Reid 1942: 299–300.

Certain genera of Polistinae:—Reid 1942: 307.

Certain species of *Polybia* Reid 1942: 308.

Two species of *Protopolybia* Reid 1942: 312.

Eleven species of *Mischocyttarus* Reid 1942: 318–319.

SPHECOIDEA
APIFORMES GROUP

Certain species of *Nasutapis* and the African species of *Braunsapis* Michener 1975: 228–229.

Certain species of African *Allodapula* and *Eucondylops* Michener 1975: 248.

Certain species of *Bombus* and *Psithyrus* Ritcher 1933: 59.

Genera of African allodapine bees Michener 1976: 36.

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⁶ It is almost impossible to determine the dates of Grandi's publications. We have tried to follow Michener 1953.